

# American Computer Science League

2022-2023 • Contest 1: Short Problems Solutions • Junior Division

<b>1. Computer Number Systems</b>  $\begin{aligned}2023_{10} &= 3 * 512 + 7 * 64 + 4 * 8 + 7 \\&= 3 * 8^3 + 7 * 8^2 + 4 * 8^1 + 7 * 8^0 \\&= 3747_8\end{aligned}$	B. 3747
<b>2. Computer Number Systems</b>  $657383_{16} - 654321_{16} = 3062$ $3062_{16} = 11000001100010_2 = 11\ 000\ 001\ 100\ 010_2 = 30142_8$	D. 30142
<b>3. Recursive Functions</b>  $\begin{aligned}f(18) &= f(18 - 3) + 1 = f(15) + 1 = 21 + 1 = 22 \\f(15) &= f(15 - 3) + 1 = f(12) + 1 = 20 + 1 = 21 \\f(12) &= f(12 - 3) + 1 = f(9) + 1 = 19 + 1 = 20 \\f(9) &= f(9 - 2) - 3 = f(7) - 3 = 22 - 3 = 19 \\f(7) &= f(7 - 2) - 3 = f(5) - 3 = 25 - 3 = 22 \\f(5) &= 25\end{aligned}$ Now substitute backwards.	E. 22
<b>4. Recursive Functions</b>  $\begin{aligned}f(12, 21) &= f(21 - 1, 12 + 2) + 1 = f(20, 14) + 1 = 12 + 1 = 13 \\f(20, 14) &= f(20 - 1, 14 + 2) - 3 = f(19, 16) - 3 = 15 - 3 = 12 \\f(19, 16) &= f(19 - 1, 16 + 2) - 3 = f(18, 18) - 3 = 18 - 3 = 15 \\f(18, 18) &= 18\end{aligned}$ Now substitute backwards.	A. 13
<b>5. What Does This Program Do? (Branching)</b>  Since 4, 5, 7 is not a Pythagorean triple, the else is invoked and the area of the triangle is calculated by Heron's formula. The semiperimeter, s, is $(4+5+7)/2 = 8$ . $\begin{aligned}\text{Area} &= \text{sqrt}(s * (s - a) * (s - b) * (s - c)) \\&= \text{sqrt}(8 * (8 - 4) * (8 - 5) * (8 - 7)) \\&= \text{sqrt}(8 * 4 * 3 * 1) \\&= \text{sqrt}(96)\end{aligned}$ So ans = int(sqrt(96)) = 9.	B. 9